

Groundwater Mixing Zone Application Guidance



May 1, 1997

Introduction

The mission of the Department is to promote and protect the health of the public and the environment. One of the ways the Department achieves that goal is to classify water use and to establish standards for each class. As set forth in The South Carolina Water Classifications and Standards (R.61-68 and R.61-69), all groundwaters of the State are currently classified GB. Class GB standards for inorganic and organic chemicals are set forth in the State Primary Drinking Water Regulations (R.61-58). Where the classified use is to be maintained, active cleanup measures will be the appropriate alternative. However, R.61-68 also allows the Department to establish groundwater mixing zones for releases should certain conditions be met. It should be noted that active cleanup measures may be more technically appropriate and cost-effective than establishing a mixing zone at certain sites.

The purpose of this document is to provide guidance on preparing a groundwater mixing zone application and to furnish technical recommendations on meeting the conditions established under R.61-68. The Department reserves the right at any time (during the investigation/review or after approval of a mixing zone) to deny, postpone or terminate indefinitely the mixing zone variance for geological, hydrological, biological, or toxicological reasons, or due to changes in technology or statute and/or regulation for specific media.

Each proposed mixing zone will require unique hydrogeologic information and assessment, depending on the contaminants present and hydrogeologic conditions at a site, in order to establish the mixing zone. Some characterizations may be highly detailed and others may only necessitate that minimum information be gathered. Applicants are strongly encouraged to meet with Department representatives prior to submittal of a mixing zone application to ensure that a mixing zone is a viable alternative. Continued close communication with the Department's project manager should be maintained.

Mixing Zone Criteria

The Water Classifications and Standards, R.61-68, allow a groundwater mixing zone to be issued when the following criteria are met:

- (1) reasonable measures have been taken or binding commitments are made to minimize the addition of contaminants to groundwater and/or control the migration of contaminants in groundwater;**
- (2) the groundwater in question is confined to a shallow geologic unit that has little or no potential of being an Underground Source of Drinking Water, and discharges or will discharge to surface waters without contravening the surface water standards set forth in R.61-68;**

- (3) the contaminant(s) in question occurs on the property of the applicant, and there is minimum possibility for groundwater withdrawals (present or future) to create drawdown such that contaminants would flow off-site;**
- (4) the contaminants or combination of contaminants in question are not dangerously toxic, mobile, or persistent.**

Use of a Mixing Zone

To meet the criteria outlined above, mixing zones may be considered in situations where the source has been removed and/or controlled and the contaminants are naturally attenuating, i.e., at or near equilibrium (especially in the case of biodegradable compounds). Therefore, mixing zones are kept to as small a volume of the site as possible and will not be allowed to increase over time. Mixing zones may be issued in conjunction with active or passive corrective action or may be established at the termination of a cleanup (i.e., the remaining concentrations will attenuate over a reasonable period of time).

Mixing Zone Application

All pertinent hydrological and technical information demonstrating that the ground water mixing zone criteria are met should be included with the mixing zone application (e.g., data summaries, appropriate diagrams, pertinent hydrogeological information, etc.). The mixing zone application will normally be reviewed by the same Department personnel who have been providing assistance/oversight throughout the site assessment. Input from other program areas within the Department may be sought.

Demonstration Criteria

Adequate information must be provided to show that the mixing zone criteria can be met. For example, the applicant should demonstrate the following:

- The source has been removed, remediated, and/or contained to minimize additional contamination of the aquifer and/or prevent exposure to any receptor. Examples of sources can include specific units (e.g., solid waste units, aboveground storage tanks, wastewater lagoons, etc.) or free-phase product (such as petroleum fuels or solvents).
- Groundwater quality has been adequately characterized by establishing the types and concentrations of contaminants that exist at the site. The parameters to be analyzed should include all components of the material released and their degradation products that are potentially water soluble.
- The horizontal and vertical extent of soil and/or groundwater contamination and the plume movement are adequately defined (i.e., so that the extent and severity of contamination can be reasonably understood). The vertical movement should be especially well documented in potential

recharge areas.

- The contaminants are confined and will remain confined to a shallow geologic unit until they either discharge to surface water or attenuate to standards onsite. The contaminants can not migrate to a deeper aquifer and cause a violation (exceedance) of accepted standards (MCLs, etc.). Compliance wells may be necessary for the zone beneath the plume (Figure 1).

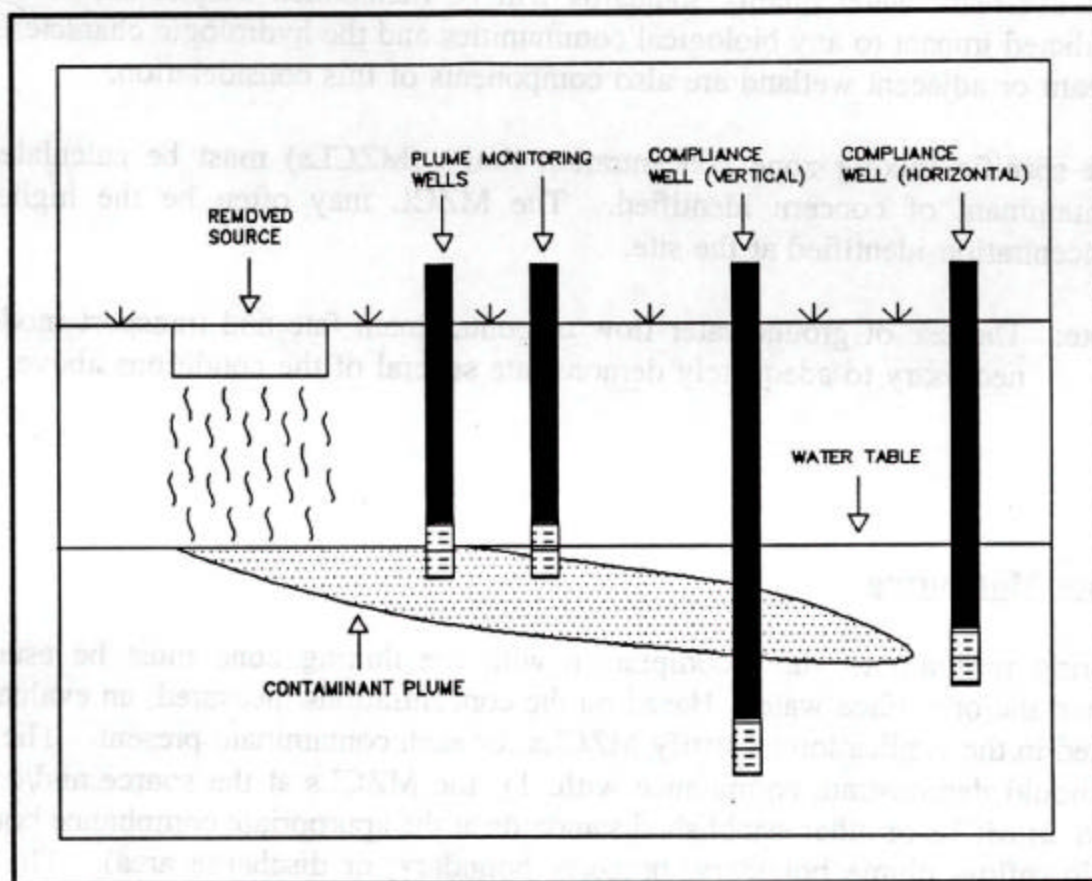


FIGURE 1. Compliance monitoring scenario with horizontal (down-gradient) monitoring and vertical (depth) monitoring

- The area (or volume) of contamination that exceeds the standards is not significantly increasing prior to discharge or attenuation.
- Contaminant concentrations (above Class GB standards) will not extend from the property on which the source occurs to an offsite property or beyond an established compliance boundary (discussed later in the document). This demonstration should be based on hydrogeologic evidence and other factors affecting contaminant fate and transport. Realistic values should be used in calculations and models; however, conservative values should be utilized for variables where uncertainty exists as a way to minimize the likelihood predicted values will be exceeded by actual

data.

- Potential receptors (e.g., drinking water wells) have been identified.
- There is no current use, and is a minimum potential for future use, of groundwater on-site as drinking water for the anticipated duration of the mixing zone. If groundwater is used in the surrounding area, the applicant should demonstrate (e.g., groundwater models, etc.) that the use will not cause contaminants to migrate offsite.
- If groundwater discharges (or will discharge) to surface water onsite or at the property boundary, appropriate data must be obtained to identify the types, concentrations and rate of contaminants discharging to the surface water. The applicant will need to document that in-stream water quality standards will be maintained despite the discharge. The predicted impact to any biological communities and the hydrologic characteristics of the stream or adjacent wetland are also components of this consideration.
- Site-specific mixing zone concentration limits (MZCLs) must be calculated for each contaminant of concern identified. The MZCL may often be the highest existing concentration identified at the site.

Note: The use of groundwater flow or contaminant fate and transport models may be necessary to adequately demonstrate several of the conditions above.

Compliance Monitoring

A monitoring program to show compliance with the mixing zone must be established for groundwater and/or surface water. Based on the concentrations measured, an evaluation should be presented in the application to justify MZCLs for each contaminant present. The monitoring program should demonstrate compliance with: 1) the MZCLs at the source and/or within the plume, and 2) MCLs or other established standards at the appropriate compliance boundary (i.e., near the downflow plume boundary, property boundary, or discharge area). The monitoring program will continue until Class GB standards are re-attained. Should an MZCL or MCL be exceeded at a compliance monitoring point, an immediate response action to insure compliance must be implemented. A response plan (i.e., a pre-approved remedial action to re-obtain compliance) will be included in the binding agreement.

Compliance Monitoring with a Surface Water Discharge

Monitoring wells need to be installed at an appropriate distance between the former source and the discharge area to form a compliance boundary to allow detection of contaminants in adequate time to initiate appropriate responses (Figure 2). Established limits (i.e., those contaminant concentrations which may discharge to the surface water at either average annual flow rates for the protection of

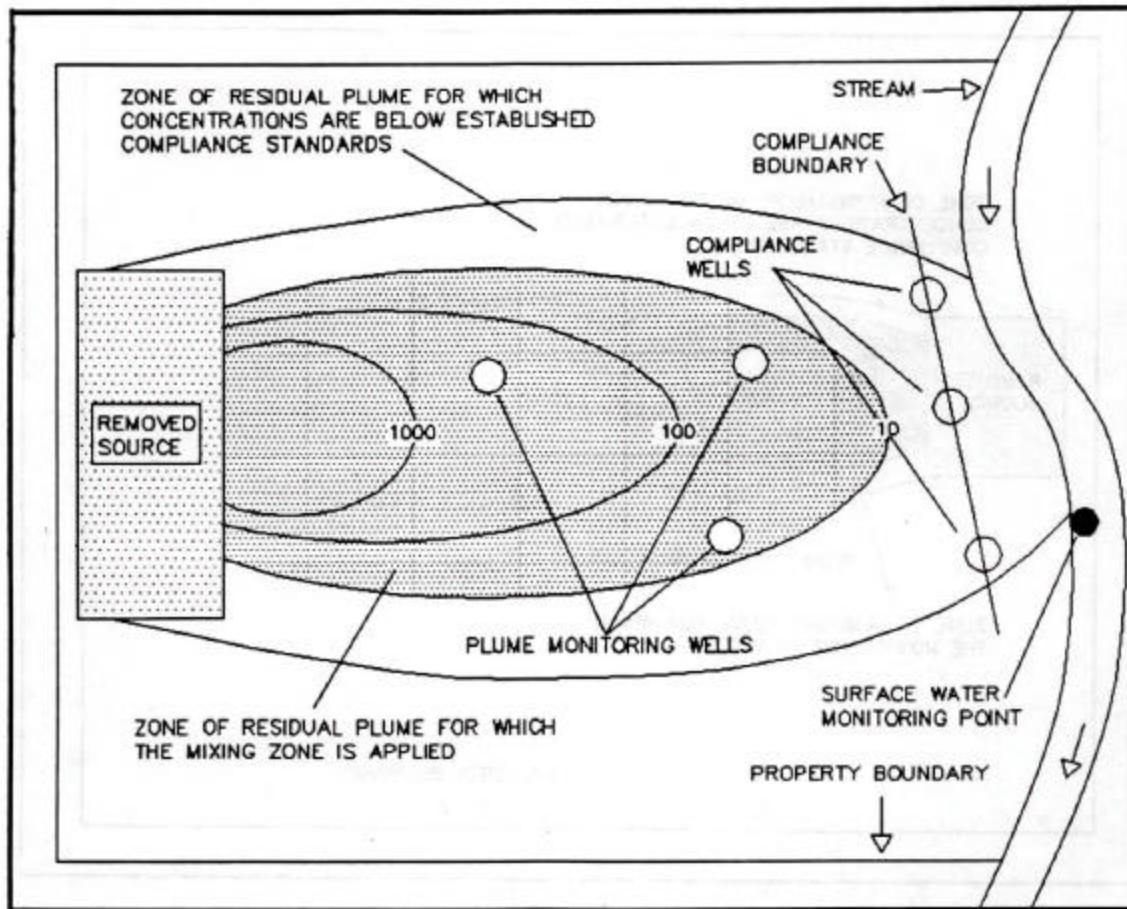


FIGURE 2. Potential Mixing Zone scenario (Plume discharging to on-site stream)

human health or at low stream-flow conditions (7Q10) without contravening the surface water and aquatic life standards) will be set for the compliance boundary (see Figure 2). Normally, water-quality monitoring of the surface waters will be necessary.

Compliance Monitoring with No Surface Water Discharge

For sites with no groundwater discharge to an onsite surface water body, or sites where the property line forms the property boundary, an onsite downflow compliance boundary will also be established. Contaminant concentrations (usually MCLs) would be set and measured at the compliance boundary. As in the case of a surface water discharge, the compliance boundary needs to provide sufficient time to initiate remedial responses should contaminants be detected above established standards. Where the property boundary is at a significant distance from the plume, the compliance boundary should generally be located near the existing terminus of the plume to prevent further degradation of large expanses of uncontaminated groundwater (Figure 3).

Additional Considerations

All documents containing geologic interpretation or engineering must be signed and sealed by a qualified professional registered in South Carolina.

Guidance documents available to provide further technical information to obtain relevant hydrogeologic information during the assessment and for corrective action of a release include “General Objectives and Components of Contamination Assessment and Remedial Actions” and “Risk-Based Corrective Action for Petroleum Releases”.

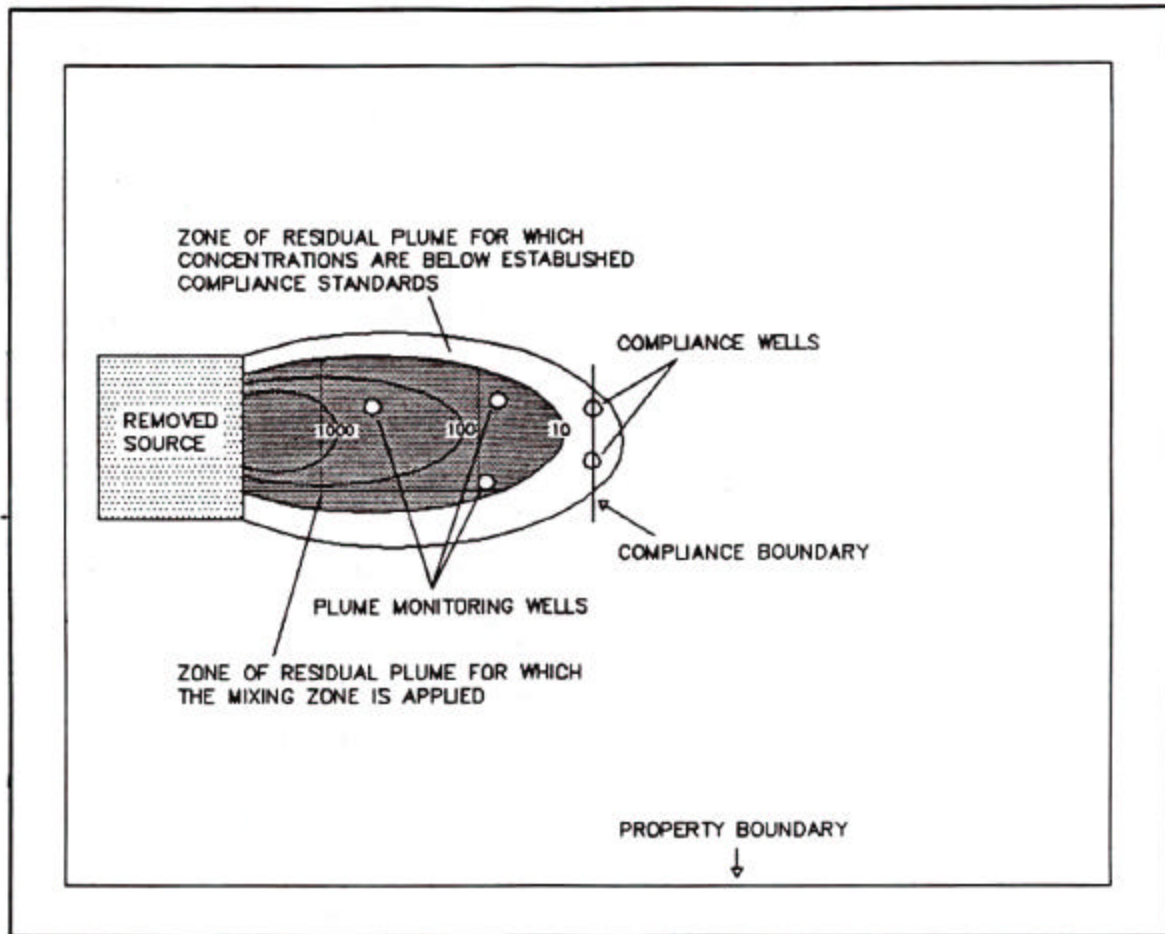


FIGURE 3. Potential Mixing Zone scenario (Plume confined to property)

Mixing Zone Agreement

The >binding agreement= by which a mixing zone may be issued can be in the form of a permit condition/modification, a consent agreement, or other regulatory authority as appropriate, which may require public notice. This enforceable agreement would describe the commitments related to:

- Compliance criteria such as associated MZCL=s and their respective monitoring points that would

be used to initiate automatic response actions and/or immediate additional remedial actions.

- A monitoring program that outlines proposed compliance criteria including compliance points, monitoring parameters and frequencies plus dates for report submittals.
- A response plan that specifies any potential immediate response actions, the conditions in which they will be initiated and the timing of the actions. This should include proposed immediate remediation actions (and their timing) to be undertaken if the groundwater standards or surface-water discharge standards are exceeded at the compliance boundary wells.